

ORIGINAL ARTICLE

Tympanoplasty: A Comparative Cross-sectional Study to Assess the Predictors of Surgical Success at a Tertiary Care Setting in KarachiTahira Ikram^{1*}, Nida Khan², Junaid Hussain³, Syeda Uzma Naqvi⁴, Muhammad Tayyab Rasheed⁵, Aiman Fatima Naqvi⁶**ABSTRACT**

Objective: To determine the factors that could affect the success of tympanoplasty and the surgical outcomes at a tertiary care hospital in Karachi.

Study Design: Comparative cross-sectional study design.

Place and Duration of Study: The study was carried out at the Department of ENT, Head and Neck Surgery, Dow University of Health Sciences, Dr. K.M Ruth Pfau Civil Hospital Karachi, Pakistan from January 2021 to January 2022.

Methods: Fifty-two patients with chronic otitis media without cholesteatoma (COMNC) who had tympanoplasty (underlay, inlay with graft) were included in this study. The examiner assessed the patients by assessment protocol that included patients who presented signs and symptoms with NCCOM with detailed history taking, a targeted physical exam (Rhinoscopy and otoscopy), nasofibroscopy, an audiogram, and video documentation via video-otoscopy to better visualize the tympanic membrane perforation. Descriptive statistics were applied to all parameters. The parameters under investigation were compared by using the chi-square test, and the Whitney U test or the Wilcoxon Rank Sum Test statistical were used for stratification considering P -value ≤ 0.05 as significant.

Results: Tympanic membrane perforations were significantly affected by factors such as age, location, and size of the perforation, number of ear infections per year, family history of hearing loss and otorrhea, history, the status of tympanic cavity, graft type, Surgery success rate, the graft, technique, or access used. The closure success rate was 73.1%.

Conclusion: Our study concluded that the factors that interfere with tympanic membrane restoration were statistically significant. After the initial surgery, the closure success rate was 73.1% with audiometric Gain.

Keywords: *Chronic Otitis, Ear Infection, Tympanoplasty.*

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Introduction

Otitis media (OM) is a widespread and significant health issue worldwide. It is characterized by inflammation or infection of the middle ear, and it can affect individuals of all ages, but it is particularly common in children.¹ Despite the advancements in medicine, including the availability of antibiotics, improved technology for diagnosis and treatment, and increased knowledge about the condition, OM continues to pose public health challenges for several reasons. This can lead to delayed diagnosis and treatment, potentially causing long-term complications.²

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Some individuals, particularly children, may experience recurrent episodes of OM. This can be frustrating for both patients and their families, as it can disrupt their daily lives and lead to repeated courses of treatment.³ OM can result in temporary or permanent hearing loss, particularly in children. Hearing impairment can have long-lasting effects on a child's development and educational progress.⁴ Chronic or recurrent OM can cause psychological distress in affected individuals, especially children. The pain, discomfort, and hearing issues can lead to anxiety, behavioral problems, and even developmental delays.⁵

Non-Cholesteatomatous Chronic Otitis Media (NCCOM) is the more common form, characterized by a persistent inflammatory process in the middle ear and otorrhea (discharge from the ear).^{6,7} NCCOM does not involve the formation of a cholesteatoma. It is typically a result of chronic inflammation and the accumulation of keratinized skin cells.⁸ The cholesteatoma can erode surrounding bone and structures within the ear, leading to complications such as hearing loss, dizziness, and potential intracranial or infratemporal complications if left untreated.⁹

Both forms of chronic otitis media are typically associated with long-term middle ear inflammation, recurrent ear infections, and a range of symptoms such as hearing loss, ear pain, and otorrhea. Treatment usually involves medical management, which may include antibiotics for infections and surgical intervention to address tympanic membrane perforations, drainage of middle ear fluid, and the removal of cholesteatomas in the case of CCOM.¹⁰ Early diagnosis and appropriate management are crucial to prevent complications and preserve hearing and ear health. Tympanoplasty is a surgical procedure that involves the reconstruction of the tympanic membrane and ossicular chain. No previous study is available in local or international literature.

Methods

The comparative study design was conducted at the ENT Department, Head and Neck Surgery, Dow University of Health Sciences, Dr. K.M Ruth Pfau Civil Hospital Karachi, Pakistan from January 2021 to January 2022 after taking approval from the Ethical Review Committee of the university held on dated: 10th January 2021 vide letter no: IRB-1974/Approval/2021.

After taking written informed consent, fifty-two patients diagnosed with NCCOM presented in the OPD of Ear, Nose, and Throat (ENT) department were included through a non-probability consecutive sampling approach. The sample size was calculated by usage of an open EPI sample calculator taking stability of anatomical pathway 8.0% and 5% margin of errors and 95%. The examiner assessed the patients by assessment protocol that included patients who presented with NCCOM with detailed history taking, a targeted physical exam (Rhinoscopy and otoscopy), nasofibroscope procedure to assess tympanic membrane perforation patients. A detailed medical history, asking about the patient's ear symptoms, previous ear infections, and any treatments that were taken. A thorough examination of the ear and surrounding structures was performed. A CT scan provides detailed cross-sectional images of the temporal bone and can reveal structural abnormalities, such as bone erosion or middle ear effusion.

Under general anesthesia, all the procedure was performed. If the perforation is 40% then the in-lay technique was used and for larger perforations underlay approach was used. There are two established techniques of myringoplasty, in the overlay technique we place the graft lateral to the fibrous layer of the tympanic membrane. Inlay technique we place the graft medial to the tympanic membrane remnant. The transmeatal approach was used when the perforation border was visible.

After leaving the hospital, oral medication is continued for a week. Following surgery, patients were seen again after the first week, 2nd week, 4th week, 8th weeks 90 days, and 120 days. After 12 Weeks of the surgical process, the first audiogram was done to assess functional progress. The parameters under investigation were compared

before and after surgery using the Mann-Whitney, Chi-squared, t-test, and Wilcoxon statistical tests.

Inclusion Criteria: Patients, either gender with age 13_56 years diagnosed with NCCOM by signs and symptoms.

Exclusion Criteria: Patients with cholesteatoma, non-type I tympanoplasty, combined procedures like ossiculoplasty and cortical mastoidectomy, or patients with certain inflammatory diseases (like SLE

and tuberculosis) were excluded from the study.

Results

In this study, 52 patients became the participants of the research in which 16 (30.8%) were male, whereas 36 (69.2%) were female. The average age of the 52 patients with (NCCOM) was 28 ± 8 years (13 to 56 years). (Table-1).

.The perforation on the right side was 71.2% (37 patients) and perforation on the left side was 15

Descriptive Statistics	n (%)
Age (Years)	
Median (Range)	20.00 (28-10)
Gender	
Male	16 (30.8%)
Female	36 (69.2%)
Perforation Side	
Right	37 (71.2%)
Left	15 (28.2%)
Perforation Location	
Anterior Inferior Quadrant	41 (78.8%)
Posterior Inferior Quadrant	11 (21.2%)
Ear infection per year	
Once	5 (9.6%)
Twice	13 (25.0%)
≥3 Times	34 (65.4%)
Status of Tympanic Cavity	
Tympanosclerosis	9 (17.3%)
Non-hypoplastic Mucosa	43 (82.7%)
Tympanoplasty	
Transmeatal Tympanoplasty	41 (78.8%)
Retro-auricular Tympanoplasty	11 (21.2%)
Graft Type	
Cartilage	12 (23.1%)
Fascia	40 (76.9%)
Surgery Success	
Considering Tympanic Membrane perforation	38 (73.1%)
Need Surgery Again	14 (26.9%)

(28.8%) patients on the left side. The perforations on postero-inferior 11 (21.2%) were more frequently located on the antero-inferior quadrant 41 (78.8%). Temporal muscle fascia was used as a graft in 40 (76.9%) and 12 (23.1%) used cartilage from the tragus. The patients underwent transmeatal tympanoplasty were 41 (78.8%) and 11 (21.2%) underwent retroauricular tympanoplasty. Out of the total sample size, 34 (65.4%) had three times ear

infections per year 13 (25%) of the patients had ear infections twice a year, and 5 (9.6%) had ear infections once per year. Tympanosclerosis affected 9 (17.3%) patients and 43 (82.7%), and the tympanic cavity had non-hypoplastic mucosa. The success rate of the Surgery was 38 (73.1%) had their tympanic membrane perforations closed (Table-1). The 14 (26.9%) patients needed surgery again. The audiogram showed auditory gain in patients who had

perforation repair completely and the average gain was 18.7 dBHL. In terms of perforation size, 39 (75%) had decreased perforations, 9 (17.3%) had increased perforations and 5 (7.7%) maintained their preoperative perforations size.

The association between the perforation site and tympanoplasty was found using the Pearson chi-square test. It is found that there is a significant relationship between these two variables ($\chi^2 =$

34.413, $P = 0.001$). In this context, the perforation site is directly associated with the success rate of tympanoplasty. For this purpose, there is a need to critically focus on the perforation site before planning for the tympanoplasty. Nevertheless, tympanoplasty has to be done at any perforation site, but the results reveal that the particular perforation site influences the success rate of the surgery.

Table-2: Association between tympanoplasty and graft type

Count		Graft.Type		Total	Chi-Square/ P-Value
		Cartilage	Fascia		
Tympanoplasty	Transmeatal tympanoplasty	2	39	41	$\chi^2 = 34.413$ $P = 0.001$
	Retroauricular tympanoplasty	10	1	11	
Total		12	40	52	

Chisquare shows the significant relationship between graft type & tympanoplasty with $P < 0.001$. It has also been revealed that fascia graft type was used in transmeatal tympanoplasty whereas cartilage graft type was applied in Retroauricular tympanoplasty. So, the selection of graft type is essential based on particular tympanoplasty procedure. Overall, the graft type is directly associated with the success rate of tympanoplasty. Nevertheless, graft type is not highly contributed in the success rate of tympanoplasty, but still there is a need to critically focus on the graft type for the sake of increasing the closure success rate of tympanoplasty. (Table-2).

It reveals that the success rate of tympanoplasty is highly dependent on several variables. In this context, the medical department has to critically focus on the entire associated factors that influence the performance of tympanoplasty.

Discussion

Chronic otitis and middle ear infections cause severe medical complications for the patients such as permanent change of the bone and mastoiditis.¹¹ Meanwhile, chronic otitis can't easily be dealt with the medications. For this purpose, Tympanoplasty is considered to be beneficial for the treatment of chronic otitis.¹² It is observed that the success rate of Tympanoplasty is selected by several factors such as age, location, and size of the perforation, number of ear infections per year, family history of hearing loss and otorrhea, history, the status of tympanic cavity,

graft type, Surgery success rate, the graft, technique, or access used that needs to be focused before the surgery.^{13,14}

It is found that the perforation site was more effective as compared to the perforation size.¹⁵ In this way, the location of the perforation needs to be critically focused for the sake of getting the positive consequences of the surgery. This fact needs to be kept in mind that proper planning is essential for performing Tympanoplasty. For this purpose, the location of perforation is directly associated with the planning of Tympanoplasty that influences the success rate of surgery. Meanwhile, variables including the type of graft used, the onset of the disease, the frequency of infections each year, and the proportion of the membrane involved in the perforation prove to be statistically significant for achieving surgical success.

There is also a need to critically focus on the association between the types of graft and the success rate of Tympanoplasty. The type of grafts used in our study were fascia and tragus cartilage pericondrium, dura mater, vein walls, and temporal muscle fascia. The type of graft tragus cartilage has proven to be quite successful in treating perforations in almost 40% of the tympanic membrane cases but it causes mild hearing loss in another study.¹⁶ It is found that the type of graft has no fundamental association with Tympanoplasty. According to Fukuchi et al. (2016), 8 (44.4%) enrolled patients showed infection postoperative, and 18 (48.6%)

patients did not have their perforations filled.¹⁷ The Poor success rate illustrated in the Fukuchi et al. study due to graft atrophy.¹⁸ The 41 (78.8%) underwent transmeatal tympanoplasty, 11 (21.2%) underwent retroauricular tympanoplasty.

The majority population of our study has 34 (65.4%), with more than three ear infections per year 13 (25%) of the patients had ear infections twice, while 5 (9.6%) have ear infections once per year. Tympanosclerosis affected 9 (17.3%) patients, and in the majority of those 43 (82.7%), the tympanic cavity had non-hypoplastic mucosa. Surgery was successful, as 38 (73.1%) had their tympanic membrane perforations closed. The 14 (26.9%) who needed surgery again. The audiogram showed an auditory gain in every patient who had complete perforation repair completely.¹⁹ The average gain was 18.7 dBHL. In terms of perforation size, 39 (75%) had decreased perforations, 9 (17.3%) had increased perforations and 4 (7.7%) maintained their preoperative perforations. We think that the fact improvement in patients hearing with complete closure success rate was 73.1% Sample size calculation technique small sample size and single-center study are the limitations of this study and this might not allow generalization of results to the population.

It is found that the success rate of tympanoplasty is associated with several variables, but the perforate rate was more effective as compared to others.²⁰ The success rate of tympanoplasty is increased because of critically focusing on the variables such as site of perforation. The onset of the infection also influences the success rate, but the planning according to the variables overcomes the effectivity of the onset of infection.

Conclusion

The closure success rate was 73.1% and audiometric gain. More structured multicenter studies are required with larger sample sizes and treatment options considered.

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Conflict of Interest: The authors declare no conflict of interest

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Authors Contribution

TI: Idea conception, study designing, data collection, data analysis, results and interpretation, manuscript writing and proofreading

NK: Study designing, data analysis, results and interpretation, manuscript writing and proofreading

JH: Idea conception, study designing, data collection, data analysis, results and interpretation

SUN: Idea conception, study designing, data collection, data analysis, results and interpretation

MTR: Idea conception, study designing, data collection, manuscript writing and proofreading

AFN: Idea conception, study designing, data collection, data analysis, results and interpretation

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